

USE OF VEGETABLE OIL AS AN ADJUVANT FOR SUBSTANCES  
HAVING A FUNGICIDE, BACTERICIDE, INSECTICIDE AND  
HERBICIDE ACTIVITY

5                                    D e s c r i p t i o n

Field of the Invention

The present invention relates to use of vegetable oil,  
in particular soybean oil, as an adjuvant for  
10 substances having a fungicide, bactericide, insecticide  
activity in preventive and curative treatments of plant  
diseases and for substances having a herbicide activity  
for control of weeds. In addition, the present  
invention pertains to a composition comprising a  
15 vegetable oil as an adjuvant, in combination with at  
least another active substance which may be a  
fungicide, bactericide, insecticide or a herbicide,  
selected from common fungicides, bactericides,  
insecticides and herbicides, as well as to use of the  
20 composition itself in preventive and curative  
treatments of plant diseases and for weedkilling over  
cultivations.

Prior Art

25 Known on the market is the presence of a great number  
of substances and compositions that are used for  
control of weeds and diseases caused by fungi, bacteria  
and insects in agricultural cultivations, in particular  
in the vine, vegetable and fruit-growing field.

30 Substantially, most of the substances and compositions  
having a fungicide, bactericide, insecticide and  
herbicide activity are synthesis substances. These  
categories of synthetic substances show a systemic,  
35 contact, cytotropic, translaminar and mesostemic

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activity for control of diseases caused by fungi, bacteria, insects and weeds.

As an alternative to synthesis products, there are also  
5 substances and compositions having a fungicide and bactericide activity of natural origin such as sulphur and copper, the latter in the form of sulphate, chloride and hydroxide, for example.

10 The above mentioned substances, whether they are of natural origin or obtained by synthesis, have several different limits: toxicology, residues, undesirable side effects, which limits however must all adapt themselves to the necessity of use in agricultural  
15 treatments for the purpose of keeping the treatments themselves efficient. Use of innovative products that may improve fruit healthiness and reduce or eliminate residues from the plant protection products is a widespread practice adopted in drawing up the regional  
20 disciplinary measures and by the firms belonging to the great distribution chains (chains of supermarkets). Often in these disciplinary measures use of synthesis products is combined with biological preparations in integrated productions, whereas the sector of  
25 biological productions is increasingly growing due both to market requirements and to the improved quality of the productions resulting from the new active ingredients. Recently, alongside the integrated and biological productions, there is a development of the  
30 industrial chain concept with the necessity of tracing the whole production system with a preference for plant protection products having a low environmental impact.

As a result, not only plant protection products are  
35 used, whenever possible, to a low amount, but they must

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also have a low environmental impact and a favourable toxicological profile (in the production disciplinary measures for the integrated defence, the plant protection products belonging to toxicological classes of the very toxic and toxic type are no longer inserted, if possible, and those of the irritant and non-classified type are favoured) and must be of the type easily degradable in the soil.

10 It is to be added that treatments even in high amounts take place with great frequency and often promote phenomena of phytotoxicity on leaves and fruits that impair the production quality. In addition, accumulation of undesired residues in fruits and soils promotes formation of strains resisting to that chemical molecule of which great use was made.

Copper as a substance of natural origin either in the form of a sulphate, an oxychloride or a hydroxide, is an active ingredient widely used both in conventional agriculture and in biological agriculture even if the limits of this active ingredient are well known, due to the natural phytotoxicity or inhibition (for more enduring cultivations) that it causes on the treated parts. Copper in all its forms and in the cases of greater sensitiveness, causes burns and necrosis on leaves and fruits restraining the production capacity of the cultivations and in addition it reduces the commercial value of the productions. It is known that in the field of vine-growing copper application adversely affects the production and quality capacity in terms of sugary degree and aromatic potential.

It is known that copper is a heavy metal accumulating in the soils without degrading and inhibiting the

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terricolous microflora or, in the worst cases, also causing intoxications to cultivations on soils that received great amounts of copper such as vine-cultivated soils. Another adverse feature typical of copper, since it is not perishable, is the high residue contained in the cultivation waste (grape stalks after wine-pressing, for example) classifying potential amending products or organic fertilizers at the same level as toxic refuse requiring precise and severe regulations for disposal.

Exactly for the above reasons, connected with the chemical nature of copper, the European Community fixed the limit of metal copper to be spread for each hectare in one year to 8 kg of active ingredient (p.a.) year/hectare. For next years a lower limit corresponding to 6 kg of p.a. per year/hectare was established.

Generally, it is known that all substances for plant protection can cause various toxicity degrees, as a side effect, towards the human beings, animals and environment.

Due to toxicology of some active ingredients of synthesis plant protection products such as bactericides, fungicides, insecticides and herbicides, application of same to low amounts is desirable in order to be able to ensure the agricultural operator's and consumers' health.

Other drawbacks imposing use of bactericide, fungicide, insecticide and herbicide substances to limited and controlled concentrations are to be found in problems resulting from accumulation in the soil and strata,

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poor selectivity of some plant protection products that can cause damages to cultivations, interference of these compositions with useful insects naturally populating orchards, vines and vegetable-cultivated  
5 fields. In addition, for bactericide, fungicide, insecticide synthesis plant protection products, there is the concrete possibility that bacterial, fungicide and insect strains resisting to treatments may be selected. Alternatively, for herbicide plant protection  
10 products there is the possibility of selecting some weeds that are less sensitive or even resistant to the herbicides employed.

From the above it appears that bactericide, fungicide,  
15 insecticide and herbicide products are not always fully efficient and harmless or safe to humans and environment; it is therefore essential that new substances should be sought for and set up.

20 In addition, there is on the market a series of compounds, called adjuvants, that are employed in combination with the substances having a fungicide, bactericide, insecticide and herbicide activity in plant treatments. The employed adjuvant, in combination  
25 with the fungicide, bactericide, insecticide and herbicide active ingredient is able to improve efficiency of the active ingredient itself while reducing amount of same. Reduction in the used amounts of the fungicide, bactericide, insecticide and  
30 herbicide active ingredient involves a reduction in the costs of the individual treatments and, in addition, also involves a reduction in the above mentioned risks.

However, the adjuvant must be a substance having a very  
35 reduced toxicity value. The adjuvant must be a

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substance that must not give rise to phytotoxicity phenomena to the plants. In addition, the adjuvant must be a substance having no contraindications both for the plants but also, and above all, for the health of the operators that must handle these substances.

Therefore, there is still a need for an adjuvant substance and/or a composition comprising said adjuvant substance capable of reducing the amounts of use of the fungicide, bactericide, insecticide and herbicide active ingredients.

In addition, there is still a need for an adjuvant substance and/or a composition comprising said adjuvant substance capable of improving the control activity of fungi, bacteria, insects and weeds in the preventive and/or curative treatments of the agricultural cultivations, in particular in the vine, vegetable and fruit-growing field.

In particular, there is a need for an adjuvant substance and/or a composition comprising said adjuvant substance having a limited toxicity and capable of restricting all problems connected with accumulation of pollutants in the soil.

#### DESCRIPTION OF THE INVENTION

The technical problem at the base of the present invention was that of selecting an adjuvant substance capable of overcoming the limits and drawbacks of the known art.

This problem was solved by the Applicant that surprisingly found it useful to use a vegetable oil as the adjuvant substance.

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In particular, water emulsions comprising a vegetable oil find a valid use as coadjuvants in the preventive and/or curative treatments of many diseases damaging  
5 and devastating the agricultural cultivations, in particular in the vine, vegetable and fruit-growing field.

In addition, a water emulsion comprising a vegetable  
10 oil in combination with active ingredients having a fungicide, bactericide, insecticide and herbicide activity find a valid use as adjuvants in the preventive and/or curative treatments of many diseases  
15 damaging and devastating the agricultural cultivations, in particular in the vine, vegetable and fruit-growing field.

Finally, the Applicant has found that water emulsions comprising a vegetable oil in combination with other  
20 substances having a fungicide, bactericide, insecticide and herbicide activity enable the amounts of use of the active ingredient in terms of concentration to be reduced, with good results.

25 It is a first object of the present invention to provide use of a vegetable oil as an adjuvant for the substances having a fungicide, bactericide and insecticide activity for the preventive and/or curative treatment of diseases caused by fungi, bacteria and  
30 insects on agricultural cultivations and use of a vegetable oil as an adjuvant for the substances having a herbicide action for control of weeds, in particular in the vine, vegetable and fruit-growing field.

35 It is another object of the present invention to

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provide a fungicide, bactericide, insecticide and herbicide composition comprising a water emulsion of a vegetable oil in combination with at least another substance having a fungicide, bactericide, insecticide and herbicide activity selected from the group consisting of fungicides, bactericides, insecticides and herbicides.

It is a further object of the present invention to provide use of said fungicide, bactericide, insecticide and herbicide composition comprising a water emulsion of a vegetable oil in combination with at least another substance having a fungicide, bactericide and insecticide activity selected from the group consisting of fungicides, bactericides and insecticides in the preventive and/or curative treatments of plant diseases and from the group consisting of herbicides in the treatments for weed control in the vine, vegetable and fruit-growing field.

Other preferred embodiments are described in the accompanying sub-claims.

Further technical features and advantages of the invention will become more apparent from the following detailed description.

The Applicant has found it useful to use a vegetable oil as the adjuvant for substances having a fungicide, bactericide, insecticide and herbicide activity in the preventive and/or curative treatments of plant diseases caused by fungi, bacteria, insects and for weed control.

Advantageously, the Applicant has found it useful to

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use a vegetable oil selected from: soybean oil, rape oil, sunflower oil, peanut oil, linseed oil, cottonseed oil, corn oil, castor oil, neem oil and olive oil in the form of a water emulsion. Also included in the context of the present invention are mixtures of one or more vegetable oils in the form of a water emulsion. The emulsion is formed by mechanical working of a mixture including water and one or more of the vegetable oils. Preferably, the emulsion is formed by mechanical working of a mixture including water and soybean oil.

Preferably, fungus selection is made from the group comprising: pythiaceae family (e.g. *Phythium* spp., *Phytophthora* spp.), peronosporaceae family (e.g. *Peronospora* spp., *Bremia* spp.), erysiphaceae family (e.g. *Uncinula necator*), helotiaceae family (e.g. *Sclerotinia* spp.), pseudosphaerialaceae family (e.g. *Venturia inequalis*), moniliaceae family (e.g. *Cercospora* spp., *Alternaria* spp., *Thielaviopsis* spp., *Cladosporium* spp., *Botritis* spp., *Monilia* spp., *Verticillium* spp.).

Preferably, bacterium selection is made from the group comprising: pseudomonadaceae family (e.g. *Pseudomonas* spp., *Xantomonas* spp.), enterobacteriaceae family (e.g. *Erwinia* spp.), corynebacteriaceae family (e.g. *Corynebacterium* spp.), streptomycetaceae family (e.g. *Streptomyces* spp.).

Preferably the insect is selected from the group comprising: coleoptera order, elateridae family (e.g. *Agriotes* spp.) chrysomelidae family (e.g. *Chaetocnema tibialis*), curculionidae family (e.g. *Conorrhynchus mendicus*), scolytidae family (e.g. *Scolytus* spp.);

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diptera order, trypetidae family (e.g. *Ceratitis capitata*); hymenoptera order, tenthredinidae family (e.g. *Hoplocampa brevis*); lepidoptera order, pyraustidae family (e.g. *Ostrinia nubilalis*), noctuidae  
 5 family (e.g. *Mamestra brassicae*), pieridae family (e.g. *Pieris brassicae*), cossidae family (e.g. *Cossus cossus*), lithocolletidae family (e.g. *Lithocolletis blancardella*), tortricidae family (e.g. *Cydia pomonella*); cochylidae family (e.g. *Eupoecilia  
 10 ambiguella*), yponomeutidae family (e.g. *Prays oleae*), lymantridae family (e.g. *Lymantria dispar*); orthoptera order, gryllotalpidae family (e.g. *Gryllotalpa gryllotalpa*); rhynchota order, aphididae family (e.g. *Myzus persicae*), flatidae family (e.g. *Metcalfa  
 15 pruinosa*), pentatomidae family (e.g. *Nezara viridula*), aleyrodidae family (e.g. *Trialeuroides vaporarium*), psyllidae family (e.g. *Psylla pyri*), diaspidinae family (e.g. *Quarospidiotus perniciosus*), pseudococcidae family (e.g. *Planococcus citri*), monophlebidae family  
 20 (e.g. *Pericerya purchasi*), coccidae family (e.g. *Saissetia oleae*), thysanoptera order, thrypidae family (e.g. *Thrips tabaci*); tetranychidae mites (e.g. *Panonychus ulmi*) eriophyidae mites (e.g. *Iculus fockeni*).

25

Preferably weed selection is made from the group comprising: malvaceae family (e.g. *Abutilon theophrasti*) compositae family (e.g. *Matricaria chamomilla*), ranunculaceae family (e.g. *Ranunculus  
 30 repens*), umbelliferae family (e.g. *Daucus carota*), labiatae family (e.g. *Lamium purpureum*), amaranthaceae family (e.g. *Amaranthus retroflexus*), primulaceae family (e.g. *Anagallis arvensis*), cruciferae family (e.g. *Sinapis arvensis*), chenopodiaceae family (e.g.  
 35 *Chenopodium album*), convolvulaceae family (e.g.

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*Convolvulus arvensis*), solanaceae family (e.g. *Solanum nigrum*), geraniaceae family (e.g. *Geranium molle*), euphorbiaceae family (e.g. *Euphorbia peplus*), polygonaceae (e.g. *Polygonum aviculare*), papaveraceae family (e.g. *Papaver rhoas*), leguminosae family (e.g. *Vicia sativa*), scrophulariaceae family (e.g. *Veronica persica*), graminaceae family (e.g. *Avena spp.*, *Lolium spp.*, *Echinochloa crusgalli*).

- 10 Preferably, plants submitted to preventive or curative treatment are selected from the group comprising: horticultural cultivations (such as tomato, potato, lettuce, strawberry, onion, celery, melon, marrow, aubergine, artichoke, French bean, cabbage), flower and
- 15 ornamental cultivations (such as rhododendron, begonia, camellia, chrysanthemum, carnation, stork's bill, gerbera, liliun, orchid, petunia, primula, rose), arboreous cultivations (such as dicotyledon, citrus, cherry, fig, almond, apple, walnut, olive, pear, peach,
- 20 plum trees, vine, flower and ornamental trees, nurseries).

The water emulsion comprising a vegetable oil, preferably soybean oil, is a stable emulsion.

25 Preferably, the emulsion comprises water in an amount included between 1 and 99% by weight or volume, with respect to the emulsion weight or volume, and vegetable oil in an amount included between 99 and 1% by weight or volume, with respect to the emulsion weight or

30 volume. Preferably, the emulsion comprises water in an amount included between 10 and 90% by weight or volume, with respect to the emulsion weight or volume, and vegetable oil in an amount included between 90 and 10% by weight or volume, with respect to the emulsion

35 weight or volume. Advantageously, the emulsion

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comprises water in an amount included between 15 and 85% by weight or volume, with respect to the weight or volume of the emulsion, and vegetable oil in an amount included between 85 and 15% by weight or volume, with respect to the emulsion weight or volume.

The physical, chemical and technical properties of the water emulsion comprising one or more vegetable oils, which is the object of the present invention, are: the absence of oxidizing properties; flash point higher than 300°C; pH (1% emulsion of soybean oil in water) 7.5; viscosity value at 25°C, 425 cps; specific gravity value at 20°C, 1 g/ml. The water emulsion object of the invention under normal environmental conditions is stable in time and keeps its features unchanged. The emulsion kept for 14 days to a temperature of 54°C did not suffer from important physico-chemical changes. At its maximum use amount, the emulsion of the invention does not show foam. Hereinbelow reproduced are tests for the emulsion emulsifiability, new emulsifiability and stability:

| Emulsifiability     | Full and uniform  |
|---------------------|---|
| Emulsion stability  | <ul style="list-style-type: none"> <li>- after 30 minutes, 3 ml of oil on the surface</li> <li>- after 3 hours, 5 ml of oil on the surface</li> <li>- after 24 hours, 5 ml of oil on the surface</li> </ul> |
| New emulsifiability | Full <ul style="list-style-type: none"> <li>- after 30 seconds: 1 ml of oil on the surface</li> <li>- after 30 minutes: 3 ml of oil on the surface</li> </ul>   |

The Applicant has found it useful to prepare a fungicide, bactericide, insecticide and herbicide

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composition comprising a stable water emulsion of a vegetable oil, preferably soybean oil, in combination with at least one substance having a fungicide, bactericide, insecticide and herbicide activity. In particular, the composition may comprise at least one substance selected from the group comprising: fungicides; insecticides; acaricides; nematocides and herbicides.

10 For instance, fungicides are selected from the following compounds:

1. Organic nitrogen-sulphur compounds such as:

- dithiocarbamates, (ziram, mancozeb), for example;
- thiazines:

15 - thiadizoles;

- thioanilides (e.g. etridiazole);
- thiocyanquinones;
- thiophanates
- thiophthalimides (e.g. folpet).

20 2. Organic nitrogen compounds such as:

- organic aromatic-aliphatic nitrogen compounds (e.g. cymoxanil, benalaxyl, metalaxyl, chlorothalonil);
- organic heterocyclic nitrogen compounds (e.g. procymidone, fludioxonil, cyprodinil; bitertanol, tetraconazole, triadimenol, dimethomorph);

25 3. Halohydrocarbons.

4. Analogues of strobilurines (e.g. azoxystrobin; trifloxystrobin);

30 5. Organic phosphorus compounds (e.g. fosetyl-aluminium)

6. Organic stannous compounds.

7. Inorganic compounds such as:

- sulphur and compounds thereof (e.g. sulphur).

35 For instance, insecticides are selected from the

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following compounds:

1. Organic nitrogen compounds such as:
  - carbamates (e.g. carbaryl, pirimicarb);
  - benzoylureas (e.g. flufenoxuron);
- 5 - chloronicotiniles (e.g. imidacloprid);
  - dyacylhydrazines
  - phenylpyrazoles (e.g. fipronil);
  - pyridine azometines
  - triazines
- 10 2. Organic nitrogen-sulphur compounds, such as:
  - dithiocarbamates (e.g. metam-sodium);
  - thiadiazines;
  - thiadiazinons (e.g. buprofezin);
  - thiocarbamates.
- 15 3. Organic chlorine compounds, such as:
  - cyclohexanes;
  - cycloheptanes (e.g. endosulfan);
  - diphenylethanes
4. Organic phosphorus compounds, such as:
  - 20 - phosphates (e.g. vamidothion, chlorpyrifos-methyl, azinphos-methyl, dimethoate, phosalone);
  - phosphonates;
  - phosphoroamidates;
  - diphosphates.
- 25 5. Halohydrocarbons
6. Phenoxy-derivatives.
7. Insecticide oils, such as:
  - mineral oils;
  - yellow oils;
- 30 8. Vegetable derivatives and similar synthetic compounds, such as:
  - flints
  - pyrethroids;
  - norpyrethrates (e.g. deltamethrin, tefluthrin,
  - 35 acrinathrin and other vegetable derivatives (e.g.

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azadirachtin, rotenone);

9. Inorganic compounds such as:

- polysulphides (e.g. barium polysulphide);
- phosphorous-derivatives

5

For instance, acaricides are selected from the following compounds:

1. Halohydrocarbons (e.g. dicofol);
2. Organic sulphur compounds (e.g. propargite);
- 10 3. Organic nitrogen compounds (e.g. amitraz, tebufenpyrad);
4. Organic nitrogen-sulphur compounds (e.g. hexythiazox);
5. Organic stannous compounds

15

For instance, nematocides are selected from the following compounds:

1. Halohydrocarbons;
2. Organic nitrogen compounds (e.g. carbosulfan);
- 20 3. Organic nitrogen-sulphur compounds (e.g. phorate).

For instance, weedkillers are selected from the following compounds:

1. Organic nitrogen compounds, such as:
  - 25 - amides (e.g. propyzamide, metolachlor, flufenacet);
  - benzonitriles (e.g. bromoxynil, ioxynil);
  - carbamates (e.g. phenmedipham);
  - urea derivatives (e.g. linuron, triflurosulfuron-methyl, oxasulfuron, rimsulfuron);
  - 30 - nitro derivatives (e.g. pendimethalin, oxyfluorfen);
  - diazines (e.g. lenacil, chloridazon);
  - dipyridyls;
  - imidazolinones (e.g. imazetapyr, imazametabenz);
  - isoxazoles (e.g. isoxaflutole);
  - 35 - oxydiazolinones (e.g. ozadiazon);

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- pyridines (e.g. clopyralid);
  - triazines (e.g. terbuthylazine, met amitron, metribuzin);
  - triazolepyrimidine-sulphonanilides (e.g. metosulam, florasulam);
  - 2. Organic phosphorus compounds (e.g. glyphosate, gluphosinate-ammonium).
  - 3. Organic stannous compounds
  - 4. Other organic compounds such as:
  - 10 - aryloxyphenoxypropionates (e.g. propaquizafop, clodinafop-propargyl, quizalofop-ethyl);
  - coumarones;
  - cyclohexanediones (e.g. sulcotrione, mesotrione);
  - cyclohexenones (e.g. cycloxydim, sethoxydim, tralkoxydim);
  - 15 - benzoic acid derivates (e.g. dicamba);
  - phenoxycarboxylic acid derivates (e.g. MCPA).
  - 5. Inorganic Compounds
- 20 Advantageously, the water emulsion comprises a vegetable oil selected from: soybean oil, rape oil, sunflower oil, peanut oil, linseed oil, cottonseed oil, corn oil, castor oil, neem oil and olive oil in a percentage of 40% by weight or volume, with respect to
- 25 the overall weight or volume of the emulsion.

In a preferred embodiment of the present invention, the water emulsion comprises soybean oil in a percentage of 40% by weight or volume with respect to the overall weight or volume of the emulsion. Practically, 400 g of soybean oil are mechanically emulsified in 1000 ml of water. The emulsion may further comprise: an additive such as polyethylene glycol glycerol rinoleate in an amount included between 0.5 and 2%, preferably 1%;

35 calcium chloride in an amount included between 0.1 and

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0.3%, preferably 0.2%; calcium phosphate in an amount included between 0.3 and 0.7%, preferably 0.5%; wheat flour in an amount included between 0.5 and 2%, preferably 1%; and water q.s. to 100%. Due to the  
5 nature of the active substance, i.e. soybean oil which is normally used in human feeding, the preparation is not toxic or dangerous.

The Applicant has carried out some experimental tests  
10 providing use of a fungicide, bactericide, insecticide or herbicide composition comprising a stable water emulsion of vegetable oil, preferably soybean oil; and:  
- at least one active substance selected from fungicides; or  
15 - at least one active substance selected from bactericides; or  
- at least one active substance selected from insecticides; or  
- at least one active substance selected from  
20 herbicides.

Alternatively, it is within the object of the present invention use of a (ternary) composition comprising a stable water emulsion of vegetable oil, preferably  
25 soybean oil; and:  
- at least one active substance selected from fungicides; and  
- at least one active substance selected from bactericides; and  
30 - at least one active substance selected from insecticides.

In a preferred embodiment of the present invention a copper-based fungicide is employed in combination with  
35 a sulphur fungicide.

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Alternatively, it is within the object of the present invention use of a (binary) combination comprising a stable water emulsion of vegetable oil, preferably soybean oil; and:

- 5 - at least one active substance selected from fungicides; and  
- at least one active substance selected from bactericides.

10 Alternatively, it is within the object of the present invention use of a (binary) composition comprising a stable water emulsion of vegetable oil, preferably soybean oil; and:

- at least one active substance selected from  
15 fungicides; and  
- at least one active substance selected from insecticides.

Alternatively, it is also within the object of the present invention use of a (binary) composition comprising a stable water emulsion of vegetable oil, preferably soybean oil, and

- at least one active substance selected from insecticides; and  
25 - at least one active substance selected from bactericides.

In the context of the present invention, for the sake of simplicity, the preparation reproduced in Example 1  
30 will be referred to as "emulsion".

#### EXAMPLE NO. 1

Preparation of a stable water emulsion comprising soybean oil in a percentage of 40% by weight or volume  
35 with respect to the overall weight or volume of the

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emulsion.

The experimental tests hereinafter reproduced involve use of an emulsion as per Example No. 1, in combination with the respective active substances, as reproduced in

5 each example:

EXAMPLE NO. 2

Cultivation : muscat vine

Soil : average admixture

10 Test target : fight against peronospora (*Plasmopara viticola*)

| Thesis<br>No. | Active<br>Ingredients  | Amounts<br>of Active<br>Ingredients<br>(g or<br>ml/ha) | No. of<br>Inter-<br>ventions | Surveys on peronospora       |                           | Action<br>Degree |
|---------------|------------------------|--|------------------------------|------------------------------|---------------------------|------------------|
|               |                        |  |                              | %<br>infection<br>on bunches | % spreading<br>on bunches |                  |
| 1             | Untreated              | -  | -                            | 4.9 a                        | 9.8 a                     | 0                |
| 2             | Mancozeb               | 1470   | 11                           | 0.2 b                        | 0.3 b                     | 97.4             |
| 3             | Mancozeb +<br>Emulsion | 490 +<br>280   | 11                           | 0.0 b                        | 0.0                       | 100              |

Statistical significance: data items followed by same letter do not differ for P=0.05 in accordance with Duncan test.

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EXAMPLE NO. 3

Cultivation : muscat vine

Soil : average admixture

Test target : fight against peronospora (*Plasmopara*  
5 *viticola*)

| Thesis<br>No. | Active<br>Ingredients  | Amounts<br>of Active<br>Ingredients<br>(g or<br>ml/ha) | No. of<br>Inter-<br>ventions | Surveys on peronospora       |                           | Action<br>Degree |
|---------------|------------------------|--|------------------------------|------------------------------|---------------------------|------------------|
|               |                        |  |                              | %<br>infection<br>on bunches | % spreading<br>on bunches |                  |
| 1             | Untreated              | -  | -                            | 4.9 a                        | 9.8 a                     | 0                |
| 2             | Folpet                 | 1200   | 11                           | 0.0 b                        | 0.0 b                     | 100              |
| 3             | Mancozeb +<br>Emulsion | 400 +<br>200   | 11                           | 0.0 b                        | 0.0 b                     | 100              |

Statistical significance: data items followed by same letter do not differ for P=0.05 in accordance with Duncan test.

EXAMPLE NO. 4

10 Cultivation : muscat vine

Soil : average admixture

Test target : fight against peronospora (*Plasmopara*  
*viticola*)

| Thesis<br>No. | Active<br>Ingredients      | Amounts<br>of Active<br>Ingredients<br>(g or<br>ml/ha) | No. of<br>Inter-<br>ventions | Surveys on peronospora       |                           | Action<br>Degree |
|---------------|----------------------------|--|------------------------------|------------------------------|---------------------------|------------------|
|               |                            |  |                              | %<br>infection<br>on bunches | % spreading<br>on bunches |                  |
| 1             | Untreated                  | -  | -                            | 4.9 a                        | 9.8 a                     | 0                |
| 2             | Dimethomorph               | 1050   | 11                           | 0.0 b                        | 0.0 b                     | 100              |
| 3             | Dimethomorph<br>+ Emulsion | 350 +<br>280   | 11                           | 0.0 b                        | 0.0 b                     | 100              |

15 Statistical significance: data items followed by same letter do not differ for P=0.05 in accordance with Duncan test.

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EXAMPLE NO. 5

Cultivation : muscat vine

Soil : average admixture

Test target : fight against peronospora (*Plasmopara viticola*)

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| Thesis<br>No. | Active<br>Ingredients      | Amounts<br>of Active<br>Ingredients<br>(g or<br>ml/ha) | No. of<br>Inter-<br>ventions | Surveys on peronospora       |                           | Action<br>Degree |
|---------------|----------------------------|--|------------------------------|------------------------------|---------------------------|------------------|
|               |                            |  |                              | %<br>infection<br>on bunches | % spreading<br>on bunches |                  |
| 1             | Untreated                  | -  | -                            | 4.9 a                        | 9.8 a                     | 0                |
| 2             | Azoxystrobin               | 250  | 11                           | 0.0 b                        | 0.0 b                     | 100              |
| 3             | Azoxystrobin<br>+ Emulsion | 83 +<br>133  | 11                           | 0.0 b                        | 0.0 b                     | 100              |

Statistical significance: data items followed by same letter do not differ for  $P=0.05$  in accordance with Duncan test.

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EXAMPLE NO. 6

Cultivation : muscat vine

Soil : average admixture

Test target : fight against peronospora (*Plasmopara*  
5 *viticola*)

| Thesis<br>No. | Active<br>Ingredients               | Amounts<br>of Active<br>Ingredients<br>(g or<br>ml/ha) | No. of<br>Inter-<br>ventions | Surveys on peronospora       |                           | Action<br>Degree |
|---------------|-------------------------------------|--|------------------------------|------------------------------|---------------------------|------------------|
|               |                                     |  |                              | %<br>infection<br>on bunches | % spreading<br>on bunches |                  |
| 1             | Untreated                           | -  | -                            | 4.9 a                        | 9.8 a                     | 0                |
| 2             | Fosetyl-<br>Aluminium               | 960  | 11                           | 0,3 b                        | 0,8 b                     | 87,2             |
| 3             | Fosetyl-<br>Aluminium +<br>Emulsion | 320 +<br>160   | 11                           | 0,8 b                        | 1,3 b                     | 87,2             |

Statistical significance: data items followed by same letter do not differ for P=0.05 in accordance with Duncan test.

EXAMPLE NO. 7

10 Cultivation : muscat vine

Soil : fresh calcareous

Test target : fight against mildew (*Uncinula necator*)

| Thesis<br>No. | Active<br>Ingredients | Amounts<br>of Active<br>Ingredients<br>(g or<br>ml/ha) | No. of<br>Inter-<br>ventions | Surveys on mildew            |                           | Action<br>Degree |
|---------------|-----------------------|--|------------------------------|------------------------------|---------------------------|------------------|
|               |                       |  |                              | %<br>infection<br>on bunches | % spreading<br>on bunches |                  |
| 1             | Untreated             | -  | -                            | 25.3 a                       | 87.3 a                    | 0                |
| 2             | Sulphur               | 4795   | 6                            | 2.2 b                        | 12.5 bd                   | 85.7             |
| 3             | Sulphur +<br>Emulsion | 1598 +<br>800  | 6                            | 1.5 b                        | 9.4 bd                    | 89.3             |

Statistical significance: data items followed by same letter do not differ for P=0.05 in accordance with Duncan test.

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EXAMPLE NO. 8

Cultivation : muscat vine

Soil : average admixture

Test target : fight against *Panonychus ulmi*

| Thesis No. | Active Ingredients         | Amounts of Active Ingredients (g or ml/ha) | No. of Inter-ventions | Surveys on <i>P. ulmi</i> |                  | Action Degree |
|------------|----------------------------|--|-----------------------|---------------------------|------------------|---------------|
|            |                            |  |                       | Mites per leaf 1          | Mites per leaf 2 |               |
| 1          | Untreated                  | -  | -                     | 3.9 a                     | 9.2 a            | 0             |
| 2          | Tebufenpyrad               | 125  | 1                     | 0.4 b                     | 1.1 b            | 80.8          |
| 3          | Tebufenpyrad<br>+ Emulsion | 41 +<br>66                                 | 1                     | 0.3 b                     | 1.8 b            | 80.8          |

- 5 Statistical significance: data items followed by same letter do not differ for P=0.05 in accordance with Duncan test.

EXAMPLE NO. 9

Cultivation : muscat vine

- 10 Soil : average admixture

Test target : fight against *Panonychus ulmi*

| Thesis No. | Active Ingredients         | Amounts of Active Ingredients (g or ml/ha) | No. of Inter-ventions | Surveys on <i>P. ulmi</i> |                  | Action Degree |
|------------|----------------------------|--|-----------------------|---------------------------|------------------|---------------|
|            |                            |  |                       | Mites per leaf 1          | Mites per leaf 2 |               |
| 1          | Untreated                  | -  | -                     | 3.9 a                     | 9.2 a            | 0             |
| 2          | Flufenoxuron               | 50   | 1                     | 1.1 b                     | 3.0 b            | 68.0          |
| 3          | Flufenoxuron<br>+ Emulsion | 15 +<br>120                                | 1                     | 0.9 b                     | 2.0 b            | 78.9          |

- Statistical significance: data items followed by same letter do not differ for P=0.05 in accordance with Duncan test.

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EXAMPLE NO. 10

Cultivation : muscat vine

Soil : average admixture

Test target : fight against *Panonychus ulmi*

| Thesis<br>No. | Active<br>Ingredients     | Amounts<br>of f.c. (g<br>or ml/ha) | No. of<br>Inter-<br>ventions | Surveys on <i>P. ulmi</i> |                     | Action<br>Degree |
|---------------|---------------------------|------------------------------------|------------------------------|---------------------------|---------------------|------------------|
|               |                           |                                    |                              | Mites per<br>leaf 1       | Mites per<br>leaf 2 |                  |
| 1             | Untreated                 | -                                  | -                            | 3.9 a                     | 9.2 a               | 0                |
| 2             | Hexythiazox               | 30                                 | 1                            | 0.0 b                     | 0.6 b               | 91.6             |
| 3             | Hexythiazox<br>+ Emulsion | 10 +<br>40                         | 1                            | 0.3 b                     | 0.8 b               | 91.6             |

- 5 Statistical significance: data items followed by same letter do not differ for P=0.05 in accordance with Duncan test.

EXAMPLE NO. 11

Cultivation : muscat vine

- 10 Soil : average admixture

Test target : fight against acid rot

| Thesis<br>No. | Active<br>Ingredients                      | Amounts<br>of f.c. (g<br>or ml/ha) | No. of<br>Inter-<br>ventions | Surveys on botritis          |                           | Action<br>Degree |
|---------------|--|------------------------------------|------------------------------|------------------------------|---------------------------|------------------|
|               |  |                                    |                              | %<br>infection<br>on bunches | % spreading<br>on bunches |                  |
| 1             | Untreated                                  | -                                  | -                            | 1.3 a                        | 40.0 a                    | 0                |
| 2             | (Cyprodinil<br>+Fludioxonil)               | (300 +<br>200)                     | 2                            | 0.2 d                        | 11.5 cd                   | 78               |
| 3             | (Cyprodinil<br>+Fludioxonil)<br>+ Emulsion | (101 +<br>68) +<br>108             | 2                            | 0.4 bd                       | 21.5 bd                   | 86.8             |

Statistical significance: data items followed by same letter do not differ for P=0.05 in accordance with Duncan test.

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EXAMPLE NO. 12

Treatment: 300 l/ha of solution were sprayed

Experimental pattern: spraying on 4 trays, each containing 8 lettuce plants

- 5 Flower survey: carried out after 14 days from treatment (T), (T + 14), and after 27 days (T + 27), stating the devitalization degree in percentage

Test target: Composite chemical weedkilling (*Lactuca sativa*)

| Thesis<br>No. | Active<br>Ingredients    | Amounts<br>of f.c.(g<br>or ml/ha) | No. of<br>Inter-<br>ventions | Surveys - %<br>devitalization |        |
|---------------|--------------------------|-----------------------------------|------------------------------|-------------------------------|--------|
|               |                          |                                   |                              | T + 14                        | T + 27 |
| 1             | Untreated                | -                                 | -                            | 0                             | 0      |
| 2             | Gliphosate               | 360                               | 1                            | 32.0                          | 90.0   |
| 3             | Gliphosate +<br>Emulsion | 360 +<br>400                      | 1                            | 32.5                          | 95.6   |

10

EXAMPLE NO. 13

Treatment: 300 l/ha of solution were sprayed

Experimental pattern: spraying on 4 trays, each containing 8 lettuce plants

- 15 Flower survey: carried out after 14 days from treatment (T), (T + 14), and after 27 days (T + 27), stating the devitalization degree in percentage

Test target: Composite chemical weedkilling (*Lactuca sativa*)

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| Thesis<br>No. | Active<br>Ingredients                 | Amounts<br>of f.c. (g<br>or ml/ha) | No. of<br>Inter-<br>ventions | Surveys - %<br>devitalization |        |
|---------------|---------------------------------------|------------------------------------|------------------------------|-------------------------------|--------|
|               |                                       |                                    |                              | T + 14                        | T + 27 |
| 1             | Untreated                             | -                                  | -                            | 0                             | 0      |
| 2             | Bromoxynil<br>octanoate               | 356                                | 1                            | 56.0                          | 67.5   |
| 3             | Bormoxynil<br>octanoate +<br>Emulsion | 356 +<br>400                       | 1                            | 60.5                          | 75.0   |

EXAMPLE NO. 14

Treatment: 300 l/ha of solution were sprayed

Experimental pattern: spraying on 4 trays, each  
5 containing 8 lettuce plants

Flower survey: carried out after 14 days from treatment  
(T), (T + 14), and after 27 days (T + 27), stating the  
devitalization degree in percentage

Test target: Composite chemical weedkilling (*Lactuga*  
10 *sativa*)

| Thesis<br>No. | Active<br>Ingredients    | Amounts<br>of f.c. (g<br>or ml/ha) | No. of<br>Inter-<br>ventions | Surveys - %<br>devitalization |        |
|---------------|--------------------------|------------------------------------|------------------------------|-------------------------------|--------|
|               |                          |                                    |                              | T + 14                        | T + 27 |
| 1             | Untreated                | -                                  | -                            | 0                             | 0      |
| 2             | Clopyradil               | 100                                | 1                            | 85.0                          | 87.5   |
| 3             | Clopyradil +<br>Emulsion | 100 +<br>400                       | 1                            | 90.0                          | 95.0   |

EXAMPLE NO. 15

Treatment: 300 l/ha of solution were sprayed

Experimental pattern: spraying on 4 trays, each  
15 containing 8 lettuce plants

Flower survey: carried out after 14 days from treatment  
(T), (T + 14), and after 27 days (T + 27), stating the

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devitalization degree in percentage

Test target: Composite chemical weedkilling (*Lactuca sativa*)

| Thesis<br>No. | Active<br>Ingredients | Amounts<br>of f.c. (g<br>or ml/ha) | No. of<br>Inter-<br>ventions | Surveys - %<br>devitalization |        |
|---------------|-----------------------|------------------------------------|------------------------------|-------------------------------|--------|
|               |                       |                                    |                              | T + 14                        | T + 27 |
| 1             | Untreated             | -                                  | -                            | 0                             | 0      |
| 2             | Lenacil               | 150                                | 1                            | 11.0                          | 30.0   |
| 3             | Lenacil +<br>Emulsion | 150 +<br>120                       | 1                            | 19.0                          | 35.3   |

- 5 The above reproduced tests were carried out by adding the water-oil emulsion comprising one or more vegetable oils selected from: soybean oil, rape oil, sunflower oil, peanut oil, linseed oil, cottonseed oil, corn oil, castor oil, neem oil and olive oil to active
- 10 substances such as: fungicides (mancozeb, folpet, dimethomorph, azoxystrobin, fosetyl-aluminium, sulphur); insecticides (flufenoxuron) and acaricides (tebufenpyrad, hexythiazox).
- 15 All tables and related theses reproduced herein result from an experimental activity carried out in the open field following precise protocols and experimental guidelines.
- 20 The aim of this experimental activity was that of verifying the possibility of reducing the amount of the chemical formulation employed, while keeping the activity of same unchanged towards adversities to be fought (peronospora, mildew and *Panonychus ulmi*),
- 25 thanks to addition of the adjuvant, preferably soybean oil.

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Therefore in each table, together with the untreated control specimen, the thesis relating to the active ingredient is reproduced to the standard amount suggested on the label (e.g. folpet to 1200 g/ha of active ingredient) and the thesis contemplating the same active ingredient to an amount reduced to 1/3 of the full amount with the water emulsion in an extemporaneous mixture (e.g. folpet 400 g/ha of active ingredient + stable water emulsion 200 ml/ha of active ingredient).

The methodologies for detection of the efficiency results were selected depending on: the pathology to be fought, infection, % spreading of the disease for peronospora, mildew and acid rot, and depending on the count of the mite number per leaf in the fight tests against *Panonychus ulmi*.

In order to minimize the result variability, which is outside the true behaviour of a given fight means against a certain adversity, there are standardized protocols and experimental guidelines to be applied in a precise and meticulous manner. At all events the experimental error is always present in interpreting the results of a test. Acknowledgement of such an error and therefore possible scientific validation is carried out by statistical working out of the results and data items resulting from the experimental test.

The statistical data item interpretation is essentially based on the calculation of the "variance" or the square of the standard deviation. As known, the "mean" evaluates the average value of a data item series and the "variance" on the contrary evaluates how much these data items deviates from the average of the same

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series.

The variance analysis leads to the evaluation of the significance of an experimental data item, in other words it leads to the evaluation of its reproducibility and its real correlation with the factor under examination.

The minimum significance must be at least equal to  $P = 0.05$  (5%).

Example: if, based on the variance calculation, two values are evaluated significantly different from each other for  $P=0.05$ , it means that the probability that the same values will be different from each other by mere chance is 5%. Therefore, there is a 95% probability that these data items will be really different and correlated with the factors they numerically represent. In addition, should the same experimental test be repeated further 100 times under the same operating conditions, in 95 cases out of 100 the same data items would be significantly different and not by mere chance.

Among the great number of statistical tests interpreting the experimental data items, Duncan test in the scientific field is considered as one of the best evaluation instruments for significance of the experimental data items. The test allocates a letter to each number; to the same letter correspond numbers evaluated as not significantly different.

Example: 12.5 a                      0.9 b                      0.3 b

Although 0.9 and 0.3 are numerically different, they are evaluated, in connection with 12.5, as not

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significantly different from each other but both of them are evaluated as significantly different from 12.5.

- 5 Examples 12-15 relate to tests carried out by adding the water-oil emulsion comprising soybean oil to herbicides (glyphosate, bromoxynyl, clopyralid, lenacil). However experimental tests were carried out with use of a water emulsion comprising rape oil,  
10 sunflower oil, peanut oil, linseed oil, cottonseed oil, corn oil, castor oil, neem oil and olive oil, which tests gave similar results as compared with those obtained by use of soybean oil.
- 15 The requirement of identifying, for all extensive cultivations (for instance wheat, corn, sugar beet, soybean), protection techniques against weeds with a lower chemical input has addressed to the research applied to examination of all factors that can help in  
20 improving efficiency of the active ingredients spread and selectivity towards a cultivation. Of these, use of adjuvants in a mixture with post-emergency herbicides represents a technical element of sure interest.
- 25 With reference to the active ingredients employed in examples 12-15, it was an aim of this experimental research to verify the influence of the emulsion addition on the herbicide activity towards a target weed belonging to the *compositae* family. By virtue of  
30 the high herbicide activity of weedkillers, when applied in the amounts on the label, and in order to highlight possible efficiency variations of same among the different theses dealt with, all active ingredients were employed alone in amounts reduced by 1/3 and  
35 reduced by 1/3 in an extemporaneous mixture with the

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emulsion being the object of the present invention.  
Example: should the active ingredients have been  
employed to the amounts reproduced on the label, it  
would have been very likely to obtain a 100%  
5 devitalization of the weed with the active ingredient  
alone and in a mixture with the emulsion.

Therefore it is reproduced in each table, together with  
the untreated control specimen, the thesis relating to  
10 the active ingredient, to the standard amount suggested  
on the label reduced by 1/3 (e.g. glyphosate at 360  
ml/ha of active ingredient) and the thesis  
contemplating the same active ingredient in an amount  
reduced by 1/3 with respect to the full amount with the  
15 emulsion in an extemporaneous mixture (e.g. glyphosate  
360 ml/ha of active ingredient + emulsion 400 ml/ha of  
active ingredient).

As to the methodologies for efficiency detection, a  
20 visual estimation was selected, by allocating a % value  
to the overall devitalizing activity observed on the  
target plant.

In the case of experimental tests concerning chemical  
25 weedkilling, while the remarks on the importance of a  
statistical evaluation for tests with fungicides are  
still valid, an agronomic evaluation does not always  
require a statistical confirmation because fight  
against weeds has distinct characters. In particular,  
30 even activity differences of a small number of percent  
points (statistically non-significant) can lead to  
noticeable differences from an agronomic point of view,  
because the primary aim is that of eliminating or  
reducing the weed competition towards the concerned  
35 cultivation. This effect can be also achieved without

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the full devitalization of the weed. Example: the statistics considers as non-different a bunch of grapes damaged for 50% and a bunch damaged for 55% (also in practical terms they are not different). Alternatively,  
5 a weed devitalized for 50% could have a greater germination ability and therefore a greater ability to compete with the cultivation and cause damage, as compared with a weed identical with the first one but devitalized for 55%.

10

For the above reasons the results obtained from the herbicide efficiency tests were not interpreted under a statistical point of view.

15 In a preferred embodiment of the present invention the fungicide composition comprises a stable water emulsion of one or more vegetable oils selected from: soybean oil, rape oil, sunflower oil, peanut oil, linseed oil, cottonseed oil, corn oil, castor oil, neem oil and  
20 olive oil in combination with other copper-based products.

Advantageously, the fungicide composition comprises a stable water emulsion of soybean oil in combination  
25 with other copper-based products.

The copper-including composition is particularly adapted for reducing fungus diseases, caused by *Phycomyces* belonging to the *peronosporaceae* family on  
30 several different cultivations. Cultivations on which the copper-including composition was tested are, for example: citrus fruit, vine, strawberry, bulb vegetables (garlic and onion), fruit vegetables (tomato, pepper, aubergine, melon, cucumber) cabbage,  
35 leaf vegetables (lettuce, spinach, beet and mangel-

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wurzel), fresh and pulse leguminous plants (beans and peas), potato, sugar beet, tobacco, ornamental flowers.

Advantageously, the stable water emulsion of soybean  
5 oil is employed to the same reduced amount as the  
copper-based preparation (from oxychloride, hydroxide,  
sulphate) with which it is mixed. For instance, in an  
amount ratio 1:1, if the amount of the cupric product  
corresponds to 100 ml/g/hl the water emulsion amount,  
10 with 40% soybean oil for example, is 100 ml/hl.  
Alternatively, if on the contrary the copper-based  
product is applied to 200 ml/g/hl the water emulsion  
amount, with 40% soybean oil for example, is 200 ml/hl.

15 The Applicant has surprisingly found that the reduction  
in the copper-based product amounts is included within  
1/3 to 1/6 of the normal use amount. Practically, 300  
ml/g/hl of copper formulation can be reduced from a  
minimum of three times (100 ml/g/hl) to a maximum of  
20 six times (50 ml/g/hl) depending on the sensibility  
degree of the cultivation and the disease pressure that  
is wished to be fought.

In addition, use of the emulsion in combination with  
25 the active ingredients does not at all modify the  
intervention strategy of the fungicides and/or  
bactericides, such as copper-based products, as  
provided by a good agricultural experience. The  
composition comprising the stable water emulsion and  
30 the active ingredient once diluted in water, is applied  
to the cultivations to be protected using normal  
spraying equipment.

As regards periods and treatment number, the  
35 instructions reproduced on the label for the

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corresponding products employed are to be followed.

The composition comprising the stable water emulsion and the active principle object of the present invention improves distribution and adhesive character of the active ingredient employed, enabling reduction in the amounts of use of the fungicide, bactericide, insecticide and herbicide. For instance, with reference to copper, it was noticed that, at the "time of lack" (20 days from application of the stable water emulsion-copper formulation mixture), the copper residue does not overcome the maximum residue admitted on treated fruits/leaves. In this connection, the following tests carried out on grapes and must are herein reproduced (Table 1).

Table 1 - Copper residues in grapes and must samples

| PRODUCT                               | Comm. Formulation<br>amount | Number of<br>applications | Copper (mg/kg or l) |      |
|---------------------------------------|-----------------------------|---------------------------|---------------------|------|
|                                       |                             |                           | Grapes              | Must |
| 40% copper<br>hydroxide               | 1800                        | 6                         | 11.70               | 1.05 |
| 40% copper<br>hydroxide +<br>emulsion | 600 + 600                   | 6                         | 4.60                | 0.26 |

The maximum copper residue allowed in grapes and in tomato corresponds to 20 mg per kg of product, whereas in the must it corresponds to 1 mg per kg or litre of product.

Tests show that, at "the time of lack" the copper values are under the limits established by law.

The Applicant has carried out some experimental tests using the water emulsion object of the present

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invention in a mixture with some copper formulations. The tests aimed at evaluating, on the one hand, the efficiency of a composition comprising a water emulsion of soybean oil admixed with some copper products and, on the other hand, the efficiency of the copper products employed by their own. The tests carried out were the following:

- 1) Efficiency evaluation when admixed with copper oxychloride and cupric hydroxide for peronospora (*Phytophthora infestans*) control on tomato (Table 2);
- 2) Efficiency evaluation when admixed with copper oxychloride and cupric hydroxide for peronospora (*Plasmopara viticola*) control on vine (Table 3);
- 3) Efficiency of the soybean-oil water emulsion admixed with copper formulations for peronospora (*Phytophthora infestans*) control on tomato (Table 4);
- 4) Efficiency of the soybean-oil water emulsion admixed with cupric hydroxide and cupric sulphate for peronospora (*Plasmopara viticola*) control on vine (Table 5);
- 5) Efficiency of the soybean-oil water emulsion admixed with cupric hydroxide and cupric sulphate for peronospora (*Plasmopara viticola*) control on vine (Table 6).

Table 2 *Phytophthora infestans* on tomato

| No. | Product                           | Amount (g/hl) |           | % infected surface per plant on 25 plants per parcel of land |          | Fruit infection on 25 plants per parcel of land on harvesting (06/09) |                               |
|-----|-----------------------------------|---------------|-----------|--|----------|---|-------------------------------|
|     |                                   | f.c.          | p.a.      | 01/09/99   | 09/09/99 | % infected fruits/plant   | % plants with infected fruits |
| 1   | Untreated                         | -             | -         | 36.1 a   | 85.8 a   | 6.9 a   | 100 a                         |
| 2   | 50% copper oxychloride + emulsion | 200 + 200     | 100 + 80  | 11.0 bcd   | 22.2 c   | 1.7 b   | 44.0 c                        |
| 3   | 50% copper oxychloride + emulsion | 100 + 100     | 50 + 40   | 10.9 bcd   | 28.9 b   | 1.9 b   | 60.0 b                        |
| 4   | 50% copper oxychloride + emulsion | 50 + 50       | 25 + 20   | 12.1 bc  | 30.0 b   | 2.2 b   | 56.0 b                        |
| 5   | 50% copper oxychloride            | 300           | 150       | 12.9 b   | 19.5 c   | 0.8 cd  | 25.0 ef                       |
| 6   | 40% cupric hydroxide + emulsion   | 250 + 250     | 100 + 100 | 7.0 e  | 9.2 d    | 0.4 de  | 18.0 fg                       |
| 7   | 40% cupric hydroxide + emulsion   | 200 + 200     | 50 + 50   | 9.2 cde  | 15.8 cd  | 0.8 cd  | 32.0 de                       |
| 8   | 40% cupric hydroxide + emulsion   | 100 + 100     | 25 + 25   | 9.3 cde  | 16.0 cd  | 1.1 c   | 39.0 cd                       |
| 9   | 40% cupric hydroxide              | 300           | 120       | 8.3 de   | 11.4 d   | 0.2 e   | 13.0 g                        |

Data items followed by same letter do not differ for P=0.05 according to Duncan test

Table 3 *Plasmopara viticola* on vine

| No. | Product                           | Amount (g/hl) |           | % infected leaf surface on 100 leaves per parcel of land |          | % infected leaves on 100 leaves per parcel of land |          |
|-----|-----------------------------------|---------------|-----------|--|----------|--|----------|
|     |                                   | f.c.          | p.a.      | 12/08/99   | 23/08/99 | 12/08/99   | 23/08/99 |
| 1   | Untreated                         | -             | -         | 15.1 a   | 22.7 a   | 58.8 a   | 67.3 a   |
| 2   | 50% copper oxychloride + emulsion | 200 + 200     | 100 + 80  | 3.6 bc   | 3.4 b    | 25.5 bc  | 26.0 b   |
| 3   | 50% copper oxychloride + emulsion | 100 + 100     | 50 + 40   | 3.8 bc   | 6.3 b    | 26.3 bc  | 35.3 b   |
| 4   | 50% copper oxychloride + emulsion | 50 + 50       | 25 + 20   | 5.3 bc   | 6.3 b    | 32.3 b   | 35.0 b   |
| 5   | 50% copper oxychloride            | 300           | 150       | 3.0 c  | 5.5 b    | 23.3 bc  | 31.3 b   |
| 6   | 40% cupric hydroxide + emulsion   | 250 + 250     | 100 + 100 | 2.2 c  | 3.1 b    | 19.8 c   | 23.5 b   |
| 7   | 40% cupric hydroxide + emulsion   | 200 + 200     | 50 + 50   | 3.7 bc   | 4.2 b    | 27.5 bc  | 29.0 b   |
| 8   | 40% cupric hydroxide + emulsion   | 100 + 100     | 25 + 25   | 6.3 b  | 6.6 b    | 33.3 b   | 30.3 b   |
| 9   | 40% cupric hydroxide              | 300           | 120       | 2.5 c  | 4.9 b    | 23.0 bc  | 32.8 b   |

Data items followed by same letter do not differ for  $P=0.05$  according to Duncan test

Table 4 *Phytophthora infestans* on tomato

| No. | Product                           | Amount (g/hl) |           | % infected surface per plant on 25 plants per parcel of land |          | Fruit infection on 25 plants per parcel of land on harvesting (11/09) |                               |
|-----|-----------------------------------|---------------|-----------|--|----------|---|-------------------------------|
|     |                                   | f.c.          | p.a.      | 04/09/00   | 12/09/00 | % infected fruits/plant   | % plants with infected fruits |
| 1   | Untreated                         | -             | -         | 42.3 a   | 62.8 a   | 1.8 a   | 53.0 a                        |
| 2   | 50% copper oxychloride + emulsion | 100 + 100     | 50 + 40   | 11.9 b   | 24.9 b   | 0 b   | 0 b                           |
| 3   | 50% copper oxychloride + emulsion | 50 + 50       | 25 + 20   | 11.6 b   | 23.9 b   | 0 b   | 0 b                           |
| 4   | 50% copper oxychloride            | 300           | 150       | 10.9 b   | 21.0 b   | 0 b   | 0 b                           |
| 5   | 40% cupric hydroxide + emulsion   | 100 + 100     | 40 + 40   | 10.9 b   | 22.6 b   | 0 b   | 0 b                           |
| 6   | 40% cupric hydroxide + emulsion   | 50 + 50       | 20 + 20   | 9.5 b  | 19.7 b   | 0 b   | 0 b                           |
| 7   | 40% cupric hydroxide              | 300           | 120       | 8.3 b  | 18.8 b   | 0 b   | 0 b                           |
| 8   | 20.2% cupric sulphate + emulsion  | 340 + 340     | 68.68+136 | 8.6 b  | 19.7 b   | 0 b   | 0 b                           |
| 9   | 20.2% cupric sulphate + emulsion  | 170 + 170     | 34.34+68  | 8.9 b  | 19.2 b   | 0 b   | 0 b                           |
| 10  | 20.2% Cupric sulphate             | 1000          | 202       | 13.8 b   | 22.4 b   | 0.1 b   | 3.0 b                         |

Data items followed by same letter do not differ for P=0.05 according to Duncan test

Table 5 *Plasmopara viticola* on vine

| No. | Product                          | Amount (g/hl) |           | % infected leaf surface on 100 leaves per parcel of land |          | % infected leaves on 100 leaves per parcel of land |          |
|-----|----------------------------------|---------------|-----------|--|----------|--|----------|
|     |                                  | f.c.          | p.a.      | 11/08/00   | 21/08/00 | 11/08/00   | 21/08/00 |
| 1   | Untreated                        | -             | -         | 4.1 a  | 14.3 a   | 27.8 a   | 58.3 a   |
| 2   | 40% cupric hydroxide + emulsion  | 100 + 100     | 40 + 40   | 0.6 b  | 3.6 b    | 8.0 bc   | 21.5 bc  |
| 3   | 40% cupric hydroxide + emulsion  | 50 + 50       | 20 + 20   | 0.7 b  | 3.2 b    | 9.3 b  | 23.8 b   |
| 4   | 40% cupric hydroxide             | 300           | 120       | 0.3 b  | 3.0 b    | 4.8 d  | 22.0 bc  |
| 5   | 20.2% cupric sulphate + emulsion | 340 + 340     | 68.68+136 | 0.3 b  | 2.6 b    | 4.3 d  | 19.5 c   |
| 6   | 20.2% cupric sulphate + emulsion | 170 + 170     | 34.34+68  | 0.4 b  | 3.4 b    | 6.0 cd   | 24.0 b   |
| 7   | 20.2% cupric sulphate            | 1000          | 202       | 0.3 b  | 2.5 b    | 4.0 d  | 19.5 c   |

Data items followed by same letter do not differ for  $P=0.05$  according to Duncan test

Table 6 *Plasmopara viticola* on vine

| No. | Product                           | Amount (g/hl) |            | % infected leaf surface on 100 leaves per parcel of land |          | % infected leaves on 100 leaves per parcel of land |          |
|-----|-----------------------------------|---------------|------------|--|----------|--|----------|
|     |                                   | f.c.          | p.a.       | 02/08/00   | 11/08/00 | 02/08/00   | 11/08/00 |
| 1   | Untreated                         | -             | -          | 6.3 a  | 12.3 a   | 12.3 a   | 67.3 a   |
| 2   | 50% copper oxychloride + emulsion | 170 + 170     | 85 + 68    | 0.2 b  | 0.3 b    | 0.3 b  | 5.3 b    |
| 3   | 50% copper oxychloride + emulsion | 85 + 85       | 42.5 + 34  | 0.3 b  | 0.3 b    | 0.3 b  | 5.0 b    |
| 4   | 50% copper oxychloride            | 500           | 250        | 0.1 b  | 0.2 b    | 0.2 b  | 4.0 b    |
| 5   | 20.2% cupric sulphate + emulsion  | 400 + 400     | 80.8 + 160 | 0.2 b  | 0.3 b    | 0.3 b  | 4.8 b    |
| 6   | 20.2% cupric sulphate + emulsion  | 200 + 200     | 40.4 + 80  | 0.2 b  | 0.3 b    | 0.3 b  | 5.5 b    |
| 7   | 20.2% cupric sulphate             | 1200          | 242.5      | 0.1 b  | 0.2 b    | 0.2 b  | 3.3 b    |

Data items followed by same letter do not differ for  $P=0.05$  according to Duncan test

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In the context of the present invention, by (f.c.) it is intended "commercial formulation" and by (p.a.) it is intended "active ingredient".

5 The water emulsion object of the invention has a high physical and chemical compatibility with products for plant protection. The emulsion is compatible with preparations based on copper oxychloride, cupric hydroxide, oxide (or copper oxide) and sulphate.

10

The product improves wettability, adhesion and distribution of the cupric preparations to which it is to be added.

15 In a preferred embodiment of the present invention, the application method comprises the following steps:

- preparing a stable water emulsion comprising soybean oil;
- admixing the active ingredient, a copper formulation
- 20 for example, with said emulsion to obtain a mixture;
- applying said mixture to cultivations to be treated by use of spraying means.

25 The water emulsion comprising a vegetable oil (soybean oil) is fully degradable. Therefore, as to possible phytotoxic effects on cultivations, and precautionary measures to avoid such effects, instructions for use of the active ingredients employed or the copper products admixed with said emulsion are to be followed.